DESCRIPTION

REMOTE CONTROL TOY SYSTEM, AND CONTROLLER, MODEL AND ACCESSORY DEVICE TO BE USED IN THE SAME

TECHNICAL FIELD

The present invention relates to a remote control toy system utilizing radio communication, and a controller, a model and an accessory device to be used in the remote control toy system.

BACKGROUND ART

In typical remote control toys, there is prepared a mechanism for definitely associating a controller with a model to be controlled by the controller by using an identification device, such as carrier frequencies or ID codes, in order to prevent false action of the model from being caused by jamming or the like against user's will. Even in a play form, such as a race or a battle game, premised on the assumption that there are a plurality of models, each model can be controlled accurately by only a controller associated with the model, owing to preparation of such a mechanism.

In Japanese Patent Publication No. 2713603, there is disclosed a remote control toy system including tank models associated with a plurality of controllers in one-to-one correspondence, a signal generation device for periodically sending IDs uniquely assigned to respective tank models, in a time division manner, and a management device mounted on each

tank model to determine whether the tank model has been shot by a beam gun of another tank model and discriminating the other party who has shot on the basis of an ID signal supplied from the signal generation device, in which shot information is fed back from the tank model to the controller. According to such a system, an interaction that cannot be obtained in control restricted to the limit of one-to-one correspondence between a controller and a model associated therewith can be generated in the play, and consequently the interest of the game can be enhanced.

In the system of Japanese Patent Publication No. 2713603 described above, however, a radio wave is used for communication between the controller and the model, whereas infrared rays are used for communication between models and communication between the signal generation device and the model. In addition, as for infrared ray communication, it is necessary to prepare two kinds of modules in each model: a module for emitting infrared rays narrowed down for beam gun and detecting it, and a module for detecting nondirectional infrared rays sent from the signal generation device. Therefore, the number of communication modules to be mounted on the model is large, and size reduction of the model is limited. Since each communication module consumes electric power, it is necessary to set the capacity of a battery to be mounted on the model to a large value. As a result, size reduction of the model is further limited. In the case where dry cells are actually used as power supply, their consumption is fast and the user's burden is also heavy.

DISCLOSURE OF THE INVENTION

Therefore, an object of the present invention is to provide a remote control toy system that is advantageous in size reduction of models and that can implement colorful plays, and a controller, a model and an accessory device that are to be used in the remote control toy system.

A remote control toy system of the present invention includes a plurality of sets, each set including a controller, and a model controlled in action on the basis of data transmitted from the controller so as to correspond to an operation situation of a user, and an accessory device provided as a device independent from the controllers and the models, the accessory device being capable of conducting data communication with the controllers and the models. And each of the controllers, the models, and the accessory device includes a radio communication module serving as a device for executing the data communication and capable of conducting bilateral data communication based on a same standard, and a control device for implementing various controls based on data communication conducted via the radio communication module. As a result, the above described object is achieved.

According to the present invention, each of the controller, the model and the accessory device has a radio communication module based on the same standards. Therefore, it is not necessary to mount a plurality of communication modules on the model, and consumption in the battery is also suppressed.

Therefore, the size of the model can be advantageously reduced. In addition, since bilateral data communication among the controller, the model and the accessory device is possible, it is possible to exchange various data among them and implement various controls. As a result, the interest of the play implemented by remote control of the models can be enhanced.

In the remote control toy system of the present invention, controllers may be associated with models in one-to-one correspondence to form sets. Sets may be formed by associating controllers with models in one to a plural number correspondence, a plural number to one correspondence, or a plural number to a plural number correspondence. As for the accessory device, an accessory device that is linked to at least a controller or a model, or that cooperates with at least a controller or a model to implement a specific function is preferably used. A single accessory device may be used, or a combination of a plurality of accessory devices may be used. For example, when implementing such a play that a plurality of models compete with each other, the accessory device can have a function of exerting some action, such as exerting an influence on superiority or inferiority in the play, and conducting the situation of the play.

The control device of each of the controller, the model and the accessory device is preferably formed as a computer having a microprocessor as its main component. It is desirable to implement various functions of each control device by a combination of the microprocessor and specific software. When using such control devices are used, the radio communication

module is connected to a microprocessor via a general-purpose interface such as USB, and all that is required is to exchange data of a predetermined form between the microprocessor and the radio communication module. It is not necessary for the microprocessor to be conscious of a communication protocol used in radio communication. Such a radio communication module is desirable.

In the remote control toy system of the present invention, radio communication modules according to various standards for implementing radio communication may be used. However, the model needs to be small in size and inexpensive in price. For that purpose, it is desirable to adopt communication standards that reduce the power consumption and battery burden, raise the general-purpose property, and facilitate mutual connection. In view of such a situation, it is suitable to use radio communication modules based on the Bluetooth standards. In the case where radio communication modules based on the Bluetooth standards are used, data communication is possible not only between the accessory device and controllers and between the accessory device and the models but also between controllers or between models. As a result, various controls can be implemented. Advantages obtained when using the Bluetooth standards will be made clear more concretely in embodiments described later.

In the remote control toy system of the present invention, the control device of the accessory device may include a device for receiving data sent from the controller or the model, via the radio communication module, a device for executing processing

based on information contained in the received data, and a device for generating data corresponding to a result of the processing and sending the data via the radio communication module.

In the remote control toy system of the present invention, the accessory device includes an information input section for accepting a user's information input, and the control device of the accessory device includes a device for executing predetermined processing on the basis of information input from the information input section, and a device for generating data corresponding to a result of the processing and sending the data via the radio communication module.

In these cases, by conducting data sent from the controller or the model in the accessory device or conducting processing based on information that is input on the accessory device in the accessory device, it is possible to implement, in the whole of the remote control toy system, control that cannot be implemented or hardly implemented only by remote control using a controller. Especially in the case where a plurality of models are concerned in each other to implement a specific play, it becomes possible to provide a new play form while suppressing the burden increase of controllers and models, by assigning processing, which is not suitable for becoming a burden on a specific controller or model, to the accessory device. For example, in the case where models are running a race, it is conceivable to acquire information for determining the order from each model, determine on the accessory device various restrictions such as handicaps according to the order, send data

for notifying of contents of the determined restrictions to a controller or a model, and conduct control so that the control device of the controller received the data or the model received the data impose the given restrictions.

In the case where the controller is made to execute control based on data supplied from the accessory device, the control device of the controller includes a device for receiving data sent from the accessory device, via the radio communication module, and a device for executing predetermined processing on the basis of the received data.

On the other hand, in the case where the controller is made to execute control based on data supplied from the accessory device, the control device of the model includes a device for receiving data sent from the accessory device, via the radio communication module, and a device for executing predetermined processing on the basis of the received data.

Furthermore, in the remote control toy system of the present invention, the sending device of the control device of the accessory device can execute processing of generating and sending broadcast data intended for a plurality of controllers, the receiving device of the control device of each controller can receive the broadcast data, and the executing device of the control device of each controller can execute processing common to all controllers for which the broadcast data is intended, as the predetermined processing.

Furthermore, the sending device of the control device of the accessory device can execute processing of generating and

sending broadcast data intended for a plurality of models, the receiving device of the control device of each model can receive the broadcast data, and the executing device of the control device of each model can execute processing common to all models for which the broadcast data is intended, as the predetermined processing.

By thus making the controllers or models execute the same processing by means of broadcast data, unified action and processing can be implemented in a play using a plurality of models. For example, when running a race by using a plurality of automobile models, flying can be prevented effectively if information for ordering all controllers or models to prohibit traveling, is transmitted as broadcast data until the start is permitted, and the controllers or models that have received the information execute processing for prohibiting driving of the models, as common processing. When some fault has occurred in the race, it is possible that information for restricting the maximum velocity of each model to a constant low velocity is transmitted from the accessory device as broadcast data and the control device of a controller or a model that has received the information executes processing for restricting the velocity of model.

In the remote control toy system of the present invention, each model may include a detection device for outputting a signal correlated to a play situation, the control device of each model may include a device for effecting a predetermined decision concerning the play situation on the basis of the output signal

of the detection device, and a device for generating data corresponding to a result of the decision and sending the data via the radio communication module, the control device of the accessory device may include a device for receiving data sent from the model so as to be associated with the output signal of the detection device, via the radio communication module, a device for determining restrictions concerning action of at least one model, on the basis of the received data, and a device for generating data corresponding to the determined restrictions and sending the generated data via the radio communication module, and the control device of the controller or the model may include a device for receiving data corresponding to the restrictions sent from the accessory device, via the radio communication module, and a device for setting a correspondence relation between operation of the controller and action of the model on the basis of the received data.

In this case, information for determining the play situation is sent from a model to the accessory device, and the accessory device can determine the play situation on the basis of the information. And according to the play situation, it is possible to impose some restrictions on action of at least some models. Upon receiving data corresponding to the restrictions, the control device of the controller or the model sets a correspondence relation between the operation of the controller and the action of the model on the basis of the data. As a result, the restrictions determined according to the play situation appears as a change of the correspondence relation

between the operation of the controller and the action of the model. According to such an aspect, it becomes possible to make restrictions, such as slacked reaction of the model in response to the operation of the controller or eliminated reaction, appear. Also in the case where a specific model is treated favorably in association with the play situation, other models are subject to restrictions when viewed from the model treated favorably. The present invention includes the case where such relative restrictions are generated.

In the present invention, the play situation refers to the situation of various events associated with the play implemented by a single model or a plurality of models, such as a preparation situation, an advance situation, or an end situation. For example, in the case where an automobile race is implemented, it is considered to detect the preparation situation before the start, the progress situation, such as the order, the number of laps and the traveling position in the middle of the race, and the goal situation as the play situation. Furthermore, the detection device of each model may detect the play situation of a single model, or may detect the situation of the play implemented by a plurality of models.

The device for setting a correspondence relation between operation of the controller and action of the model may change a correspondence relation between an operation quantity of the controller concerning a specific action of the model and a control quantity concerning the specific action of the model according to contents of the restrictions. As a result, it becomes possible

to make restrictions, such as the velocity that cannot be increased even if the throttle control section is operated in the automobile model, appear.

Another remote control toy system of the present invention includes a controller, and a model controlled in action on the basis of data transmitted from the controller so as to correspond to an operation situation of a user, and each of the controller and the model includes a radio communication module based on Bluetooth standards serving as a device for executing communication between the controller and the model, and a control device for executing remote control based on data communication conducted via the radio communication module.

In this case as well, various data are exchanged between the controller and the model by utilizing advantages of the Bluetooth standards. As a result, the interest of the play can be enhanced.

In another remote control toy system described above, the model includes a detection device for outputting a signal correlated to a play situation, the control device of the model includes a device for effecting a predetermined decision concerning the play situation on the basis of the output signal of the detection device, and a device for generating data corresponding to a result of the decision and sending the data via the radio communication module, and the control device of the controller includes a device for receiving data sent from the model, via the radio communication module, and a device for executing predetermined processing on the basis of the received

data.

In this case, it is possible to feedback data sent from the model to the controller and reflect the data in the control of the controller. For example, the correspondence relation between the operation of the controller and the action of the model may be influenced by the information fed back. Or a device, such as a vibrator, incorporated in the controller may be controlled on the basis of the information fed back.

A controller used in the remote control toy system of the present invention is a controller for remote controlling a model, and includes an operation input section for accepting a user's steering operation on the model, a radio communication module based on Bluetooth standards serving as a device for executing bilateral data communication between the controller and the model, and a control device for implementing various controls based on data communication conducted via the radio communication module. The control device includes a device for determining steering information so as to correspond to an operation state of the operation input section, a device for generating data containing the determined steering information and sending the data via the radio communication module, a device for receiving data sent from outside, via the radio communication module, and a device for executing predetermined processing on the basis of the received data.

A model used in the remote control toy system of the present invention is a model remote-controlled on the basis of steering information that is contained in data transmitted from a

controller. The model includes a driving source for implementing predetermined action, a radio communication module based on Bluetooth standards serving as a device for executing bilateral data communication between the model and the controller, a detection device for outputting a signal correlated to a play situation, and a control device for implementing various controls based on data communication conducted via the radio communication module. The control device includes a device for receiving data containing the steering information transmitted from the controller, via the radio communication module, a device for controlling action of the driving source on the basis of the steering information, a device for effecting a predetermined decision concerning the play situation on the basis of the output signal of the detection device, and a device for generating data corresponding to a result of the decision and sending the data via the radio communication module.

An accessory device used in the remote control toy system of the present invention is an accessory device used in combination with a controller and a model remote-controlled on the basis of data supplied from the controller. The accessory device includes a radio communication module based on Bluetooth standards serving as a device for executing bilateral data communication between the accessory device and the controller and between the accessory device and the model, and a control device for implementing various controls based on data communication conducted via the radio communication module. The control device includes a device for receiving data sent

from the controller or the model, via the radio communication module, a device for executing processing based on information contained in the received data, and a device for generating data corresponding to a result of the processing and sending the data via the radio communication module.

Another accessory device used in the remote control toy system of the present invention is an accessory device used in combination with a controller and a model remote-controlled on the basis of data supplied from the controller. The accessory device includes a radio communication module based on Bluetooth standards serving as a device for executing bilateral data communication between the accessory device and the controller and between the accessory device and the model, a control device for implementing various controls based on data communication conducted via the radio communication module, and an information input section for accepting a user's information input. The control device includes a device for executing predetermined processing on the basis of information input from the information input section, and a device for generating data corresponding to a result of the processing and sending the data via the radio communication module.

By using the controller, the model or the accessory device, a remote control toy system of the present invention can be formed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a general configuration diagram of a remote control toy system according to an embodiment of the present

invention;

FIG. 2 is a block diagram showing a configuration of a control system in a controller shown in FIG. 1;

FIG. 3 is a block diagram showing a configuration of a control system of an automobile model shown in FIG. 1;

FIG. 4 is a block diagram showing a configuration of a control system in a management machine shown in FIG. 1;

FIGS. 5A to 5D are diagrams showing outlines of data transmitted from respective devices;

FIGS. 6A and 6B are diagrams showing graphs of map data prepared in order to determine a steering angle and a velocity of an automobile model according to control quantities of a steering control section and a throttle control section of a controller;

FIG. 7 is a flow chart showing a procedure of steering information generation processing executed in a controller;

FIG. 8 is a flow chart showing a procedure of traveling restriction management processing executed in a controller;

FIG. 9 is a flow chart showing a procedure of traveling management processing executed in a controller;

FIG. 10 is a flow chart showing a procedure of lap information notification processing executed in an automobile model;

FIG. 11 is a flow chart showing a procedure of race management processing executed in an automobile model;

FIG. 12 is a flow chart showing a procedure of traveling restriction management executed in an automobile model and damage

reproduction processing executed in a controller so as to be associated with the traveling restriction management; and

FIG. 13 is a flow chart showing a procedure of manual management processing executed in a management machine.

BEST MODE FOR CARRYING OUT THE INVENTION

FIG. 1 shows an embodiment of a remote control toy system for effecting a race using an automobile model according to the present invention. A remote control toy system 1 includes four controllers 2A to 2D, four automobile models 3A to 3D respectively associated with the controllers 2A to 2D in one-to-one correspondence, one management machine 4, and a course 5. Suffixes A to D attached to the controllers 2A to 2D and the automobile models 3A to 3D indicate relations of association of the controllers with automobile models. In the ensuing description, a controller is denoted as controller 2 when it is not necessary to especially discriminate the controllers 2A to 2D, and an automobile model is denoted as automobile 3 when it is not necessary to especially discriminate the automobiles 3A to 3D.

The controller 2 includes a steering control section 2a for ordering a steering angle of the automobile model 3 and a throttle control section 2b for ordering a traveling velocity. The control sections 2a and 2b can be provided in various forms, such as a lever form or a dial form, in the same way as well-known remote control controllers. The automobile model 3 includes a steering motor, a traveling motor, and a gear box for converting

movements of respective motors to desired movements. Since details of those mechanisms are not the purport of the present invention, however, they are not illustrated. The management machine 4 is provided to manage the progress of the race. The management machine 4 includes an information input section 4a for the user to operate in order to input various kinds of information, and an information display section 4b using a liquid crystal monitor or the like. The position of the management machine 4 may be altered suitably. The course 5 defines a traveling route of the automobile model 3. The course 5 includes a main course 5a taking the shape of an ellipse, and a pit lane 5b. Bar images 5c and 5d are provided on the main course 5a and the pit lane 5b, respectively. The bar images 5c and 5d are used for lap management of the automobile model 3. The bar images 5c and 5d have mutually different patterns. For example, the bar images 5c is different from 5d in the number of bars. The layout of the course 5 may be altered arbitrarily.

As the controllers 2A to 2D, the automobiles 3A to 3D, and the management machine 4 conduct communication bilaterally according to the Bluetooth standards, the system 1 of the present invention implements various kind of control processing after mentioned. The Bluetooth standards are a kind of radio communication standards settled on under the management of a standardization organization "Bluetooth SIG". The Bluetooth standards are standards for implementing bilateral radio communication optimized for short distances.

One of features of the Bluetooth standards is that the

power consumption is reduced by taking short distances as a target. For example, in class 1 taking a transmission distance of approximately 10 m as its target, power consumption at the time of transmission is in a range of approximately 20 to 30 mW. If the automobile model 3 has at most such a size, for example, that it can be placed on a palm (for example, a scale of 1/43 as compared with an actual automobile), then a communication distance of 10 m is necessary and sufficient. And since the power consumption becomes lower, a module that conducts communication according to the Bluetooth standards is also reduced in size and the battery to be mounted on the automobile model 3 can also be reduced in size. Therefore, it is extremely advantageous in size reduction of the automobile model 3. On the other hand, in exchange for low power, the transmission rate is approximately 1 Mbps in theoretical value and approximately 433.9 Kbps in effective value. It is also a fact that the transmission rate compares unfavorably with the theoretical value 11 Mbps of IEEE 802.11, which is standards of the radio LAN. However, in the case where it is used in data communication between devices that form the remote control toy system 1, it is a sufficient transmission rate.

In addition, by putting the controllers 2A to 2D and the automobile models 3A to 3D to a pico-net formed of Bluetooth and a scatter-net, not only communication from a controller 2 to a corresponding automobile model 3 but also communication from the automobile model 3 to the controller 2 can be implemented. Furthermore, it also becomes possible to implement communication

exceeding the limit of the relation of association of the controller 2 with the automobile model 3, such as communication from the controller 2A to other controllers 2B to 2D or communication from the controller 2A to the automobile models 3B to 3D. In addition, by putting the management machine 4 separate from the controller 2 and the automobile model 3 to the pico-net or scatter-net, it is possible to conduct bilateral communication between the management machine 4 and each controller 2 or each automobile model 3. Consequently it is possible to implement general control, such as advance management of a race. In a conventional remote control toy using a radio wave transceiver, the frequency band of the carrier is altered according to the relation of association of a controller with a model, and consequently the control exceeding the limit of the association relation cannot be implemented. Furthermore, in the case where infrared ray communication represented by IrDA is used, the transmission rate is slow. In an environment having a large number of devices as in the system 1 of FIG. 1, therefore, bilateral communication cannot be conducted sufficiently. Also since the transmission distance is also approximately 1 m, infrared ray communication is not fit for use of the remote control toy system. As for standards such as IEEE 802.11 and Home RF for implementing a radio LAN, they are intended for a distance longer than the Bluetooth standards (approximately 100 m), and consequently power consumption is large and it is difficult to mount them on small-sized models. From such a point of view, the Bluetooth standards are the most optimum standards to the

remote control toy system.

According to the Bluetooth standards, communication is conducted by using the frequency hopping spread spectrum technique, and devices are divided into masters and slaves in order to attain synchronization of a hopping pattern of that frequency. One master exists in one pico-net, and up to seven slaves are connected to one master. Communication is executed always between a master and a slave. Communication between slaves is implemented by intervention of a master on the way. However, the relation between a master and a slave does not mean superiority or inferiority among devices accommodated by the pico-bet. If one of devices functions as a master, other devices synchronize with the master as slaves. In FIG. 1, such an image that the management machine 4 functions as the master is represented. As a matter of fact, however, there are various combinations of masters and slaves. For example, a certain controller 2 or automobile model 3 may function as the master. Since there are four controllers 2 and four automobile models 3 in FIG. 1, all devices including the management function 4 cannot be accommodated by one pico-net. In actuality, therefore, a device functioning as a slave of one pico-net functions as a master of another pico-net, and some devices conduct communication as slaves for the device.

Configurations of control system of respective devices will now be described with reference to FIGS. 2 to 4. FIG. 2 is a block diagram showing a configuration of a control system of the controller 2. The control system of the controller 2

includes a control device 10, a steering control section 2a, a throttle control section 2b, information input section 2c and an ID setting switch 11, which function as input devices, a ROM 12 and a RAM 13, which function as storage devices, a vibrator 15, a vibrator driving circuit 14 for driving the vibrator 15 in accordance with an order issued by the control device 10, and a Bluetooth communication module 16.

The control device 10 is formed as a computer obtained by combining a microprocessor with peripheral devices, such as a clock circuit and a buffer memory, required for action of the microprocessor. The information input section 2c is provided in a suitable position of an outside surface of the controller 2. The user can input various kinds of information from the information input section 2c. For example, the user can input information for notifying a travelling impossibility state described later or the like from the information input section 2c. The ID setting switch 11 is provided to set an ID number. The ID number is information for identifying the relation of association of a controller 2 with an automobile model 3. For example, in the case where four controllers 2 and four automobile models 3 are provided as shown in FIG. 1, 1 to 4 are prepared as ID numbers. It is necessary for each user participating in the race to set an ID number different from that of other users in the own controller 2 by operating the ID setting switch 11.

On the ROM 12, a program (not illustrated) for making the control device 10 execute predetermined processing is stored and various data required for execution of the program are

recorded. Execution of the program recorded on the ROM 12 conducted by the control device 10 forms a steering information control section 10a, an additional information control section 10b, a transmission data generation section 10c, a received data discrimination section 10d and a vibrator control section 10e, within the control device 10. The sections 10a to 10e are logical devices implemented by combinations of the microprocessor and software. However, at least a part of the sections 10a to 10e may be formed of a logical circuit.

The steering information control section 10a determines a steering angle and a velocity to be given to the automobile model 3 by referring to a control situation of the steering control section 2a and the throttle control section 2b and map data D1 recorded on the ROM 12. The map data D1 is data describing the relation of association of control quantities of the control sections 2a and 2b from initial positions with the steering angle and velocity to be given to the automobile model 3. The method for determining the steering angle and velocity by using the map data D1 will be described later. The additional information control section 10b generates additional information corresponding to the control situation of the information input section 2c. The transmission data generation section 10c generates data for controlling the action of the automobile model 3 associated with the controller 2, on the basis of information of the steering angle and velocity determined by the steering information control section 10a, additional information sent from the additional information control section 10b and ID

information set by the ID setting switch 11. For example, as shown in FIG. 5B, the data includes information specifying the ID number set by the ID setting switch, steering information specifying the steering angle, and velocity information specifying the velocity. Incidentally, by using additional information, it is also possible to make the controller 2 send information other than information concerning the action of the automobile model 3.

On the other hand, the received data discrimination section 10d determines whether received data delivered from the Bluetooth communication module 16 includes information that requires processing in the steering information control section 10a or the vibrator control section 10e. Information judged to be necessary is supplied to the steering information control section 10a or the vibrator control section 10e. Incidentally, information may be supplied from the received data discrimination section 10d to the additional information control section 10b as well. The vibrator control section 10e generates driving information of the vibrator 15 in accordance with information sent from the received data discrimination section 10d, and outputs the driving information to the vibrator driving circuit 14 as a driving order. The vibrator 15 is provided to vibrate the controller 2. A module having an eccentric weight attached to a rotation axis of a small-sized motor, which is used in a controller or the like of a video game, can be used as the vibrator 15.

The Bluetooth communication module 16 is connected to the

control device 10 via a predetermined interface 17. The Bluetooth communication module 16 is provided to transmit/receive data to/from a Bluetooth communication module of another device in accordance with a procedure (communication protocol) based upon the Bluetooth standards. Establishment of the communication protocol based upon the Bluetooth communication standards and transmission/reception of packets are controlled by the Bluetooth communication module 16. At the time of data transmission, therefore, all that the control device 10 has to do is to create and deliver transmission data in a form requested by the Bluetooth communication module 16. At the time of data reception, all that the control device 10 has to do is to interpret received data delivered from the Bluetooth communication module 16 in a predetermined form. In both data transmission and reception, it is not necessary for the control device 10 to be conscious of the communication protocol of the Bluetooth communication standards.

In data communication based on the Bluetooth communication standards, data is divided into packets each having a predetermined bit length and transmitted as shown in FIG. 5A. One packet includes an access code, a header, and a payload. The access code is an identifier for specifying a transmission subject of a packet transmitted from the Bluetooth communication module. Various kinds of information for flow control are contained in the header. A 3-bit identifier called AM_ADDR (Active Member Address), which indicates destination of the packet, is contained in the header. A packet in which all bits

of the AM_ADDR are set to 0 is handled as the so-called broadcast packet to be sent to all devices. In the system 1 of the present embodiment, the transmission subject can be specified in the protocol level of Bluetooth by using the access code and the header, or the transmission subject can be specified by using the ID of each device.

Furthermore, in the payload portion shown in FIG. 5A, data exchanged in application using the Bluetooth (in this case, programs respectively for controlling the controller 2, the automobile model 3 and the management machine 4) are contained. For example, in the case of the controller 2 shown in FIG. 2, data generated by the transmission data generation section 10c as shown in FIG. 5B becomes the content of the payload. The data of the payload is delivered from the Bluetooth communication module 16 to the received data discrimination section 10d. The same also holds true of transmission data (FIGS. 5C and 5D) respectively generated in the automobile model 3 and the management machine 4.

FIG. 3 is a block diagram showing a configuration of a control system of the automobile model 3. The control system of the automobile model 3 includes a control device 20, a steering motor 21 and a traveling motor 22 serving as control subject devices, a steering motor driving circuit 23 and a traveling motor driving circuit 24 for driving the motors 21 and 22 on the basis of orders issued by the control device 20, an ID setting switch 25, an image reader 26, and an acceleration sensor 27 serving as input devices, and a Bluetooth communication module

30.

The control device 20 is formed as a computer obtained by combining a microprocessor with peripheral devices, such as a clock circuit and a buffer memory, required for action of the microprocessor. The ID setting switch 25 is provided to set an ID number in the same way as the ID setting switch 11 of the controller 2. By setting the same ID number by using the ID switch 11 of the controller 2 and the ID switch 25 of the automobile model 3, the controller 2 can be associated with the automobile model 3.

The image reader 26 reads the bar images 5c and 5d provided on the course 5 of FIG. 1, and outputs signals corresponding to those patterns. The acceleration sensor 27 outputs a signal corresponding to vibration acceleration applied to the automobile model 3. Between the image reader 26 and the control device 20 and between the acceleration sensor 27 and the control device 20, interfaces are provided suitably, but illustration of them is omitted. The Bluetooth communication module 30 is connected to the control device 20 via a predetermined interface 29. The Bluetooth communication module 30 performs the same function as that of the Bluetooth communication module 30 shown in FIG. 2.

A ROM, which is not illustrated, is connected to the control device 20. By executing a program recorded on the ROM, a received data discrimination section 20a, a motor driving control section 20b, a lap decision section 20c, a damage decision section 20d and a transmission data generation section 20e are formed within

the control device 20. In the same way as the case of FIG. 2, the sections 20a to 20e are logical devices implemented by combinations of the microprocessor and software. However, at least a part of the sections 20a to 20e may be formed of a logical circuit.

The received data discrimination section 20a compares received data delivered from the Bluetooth communication module 30 with an ID set by the ID setting switch 25, determines whether the received data is data associated with its own ID, and determines whether steering information and velocity information shown in FIG. 5B are contained in the data. When both conditions are satisfied, the steering information and the velocity information contained in the data are supplied to the motor driving control section 20b. The motor driving control section 20b computes motor control quantities for obtaining a steering angle and a velocity corresponding to given steering information and velocity information, and outputs motor driving orders corresponding to the computation results respectively to the steering motor driving circuit 23 and the traveling motor driving circuit 24. The steering motor driving circuit 23 drives the steering motor 21 in accordance with a given motor driving order. The traveling motor driving circuit 24 drives the traveling motor 22 in accordance with a given motor driving order. As a result, the automobile model 3 is driven on the basis of steering information and velocity information transmitted from a controller 2 having a coincident ID.

On the other hand, the lap decision section 20c monitors

an output signal from the image reader 26, and supplies information corresponding to a result of monitoring to the transmission data generation section 20e. The damage decision section 20d monitors the output signal of the acceleration sensor 27, and supplies information corresponding to a result of the monitoring to the transmission data generation section 20e. The transmission data generation section 20e generates transmission data shown in FIG. 5C on the basis of the ID number set by the ID setting switch 25 and information supplied from the lap decision section 20c and the damage decision section 20d, and delivers the transmission data to the Bluetooth communication module 30. The transmission data contains information specifying the ID number set by the ID setting switch 25 and traveling state notification information corresponding to the monitored results of the lap decision section 20c and the damage decision section 20d.

FIG. 4 is a block diagram showing a configuration of a control system of the management machine 4. The management machine 4 includes the information input section 4a and the information display section 4b shown in FIG. 1, a control device 40, a RAM 41, and a Bluetooth communication module 42. The control device 40 is formed as a computer obtained by combining a microprocessor with peripheral devices, such as a clock circuit and a buffer memory, required for action of the microprocessor. The Bluetooth communication module 42 has the same function as that of the Bluetooth communication modules 16 and 30 shown in FIGS. 2 and 3.

Execution of a program recorded on a ROM, which is not illustrated, conducted by the control device 40 forms a race control section 40a, a transmission data generation section 40b and a received data discrimination section 40c, within the control section 40. In the same way as the cases of FIGS. 2 and 3, the sections 40a to 40c are logical devices implemented by combinations of the microprocessor and software. However, at least a part of each of the sections 40a to 40c may be formed of a logical circuit. The race control section 40a executes various kinds of control required for the race management by referring to the input from the information input section 4a and received data sent from the received data discrimination section 40c. On the RAM 41, race situation data D3 to be referred to when the race control section 40a executes predetermined processing is stored.

The transmission data generation section 40b generates transmission data having a form requested by the Bluetooth communication module 42 by referring to information sent from the race control section 40a, and delivers the transmission data to the Bluetooth communication module 42. For example, as shown in FIG. 5D, information specifying the ID number of a transmission subject and traveling restriction information are contained in the transmission data. Traveling restriction information is information generated for the purpose of setting predetermined restrictions on the action of the automobile model 3, but its concrete example will be described later. The received data discrimination section 40c determines whether information

required for processing of the race control section 40a is contained in data sent from the Bluetooth communication module 42, and supplies the required information to the race control section 40a.

A procedure whereby the control device 10 of the controller 2 determines the steering angle and the velocity of the automobile model 3 according to the operation situation of the steering control section 2a and the throttle control section 2b will now be described with reference to FIGS. 2, 6 and 7. FIGS. 6A and 6B show contents of map data recorded on the ROM 12 (FIG. 2) of the controller 2 in graph forms. FIG. 6A shows a relation of association of a steering angle θ supplied to the automobile model 3 with an operation quantity (a steering quantity) A from an initial position of the steering control section 2a. FIG. 6B shows a relation of association of a velocity V supplied to the automobile model 3 with an operation quantity B from an initial position of the throttle control section 2b. Incidentally, as for the initial position of the steering control section 2a, the state of going straight on at a steering angle of 0° is supposed. As for the initial position of the throttle control section 2b, a stop state having a velocity of 0 is supposed. As regards the steering angle, operation is conducted in the left and right angles. Supposing that the steering angle of the initial position is set to be 0°, originally the steering angle assumes a positive value when the steering operation is conducted in one of the left and right directions and the steering angle assumes a negative value when the steering operation is conducted in

the other of the left and right directions. In FIG. 6A, however, only the positive direction is shown. As regards the throttle control section 2b, an example of providing the automobile model 3 with only action of going straight on is shown in FIG. 6B. However, the initial position can be altered suitably. As regards the traveling velocity, a retreat, i.e., a negative value may be set.

As shown in FIGS. 6A and 6B, a plurality of relations of association are prepared as regards both the steering angle and the velocity in the remote control toy system 1. In FIGS. 6A and 6B, the relations of association are shown as steering maps 1, 2, 3, ... or velocity maps 1, 2, 3, ... in distinction. The map data D1 are data that represent the relations of association determined by graphs indicated as the maps 1, 2, 3, ..., in a predetermined form (such as a table form). The map data D1 are recorded on the ROM 12 as different data every graph of FIGS. 6A and 6B, i.e., every map 1, 2, 3, ...

The steering information control section 10a (FIG. 2) in the control device 10 of the controller 2 determines map data to be used for each of the steering angle and velocity, on the basis of traveling log data D2 stored on the RAM 13 and information supplied from the received data discrimination section 10d. In addition, the steering information control section 10a repetitively executes steering information generation processing shown in FIG. 7 at predetermined periods, and generates steering information (steering information and velocity information).

In the processing of FIG. 7, the steering information control section 10a detects operation states of the steering control section 2a and the throttle control section 2b conducted from the processing of the last time, and computes the steering quantity A and the throttle control quantity B from their respective initial positions (step S1). The steering information control section 10a then determines the steering angle θ and the velocity V respectively associated with the computed steering quantity A and throttle control quantity B on the basis of the map data D1 (steps S2 and S3). The steering information control section 10a supplies steering information and velocity information respectively associated with the determined values to the transmission data generation section 10c (step S4). Thereafter, the steering information control section 10a updates traveling log data so as to reflect the operation contents of the steering control section 2a and the throttle control section 2b detected by the processing of this time in the traveling log data D2 (FIG. 2) (step S5). By repeating such processing, data specifying the steering angle and the traveling velocity are repetitively transmitted from the controller 2 to the automobile model 3 associated with the controller 2. In the automobile model 3, only steering information contained in data transmitted from the controller 2 having a coincident ID number is supplied from the received data discrimination section 20a to the motor driving control section 20b. The motors 21 and 22 are driven on the basis of the information.

In the system 1 of the present embodiment, a plurality of relations between the steering quantity A and the throttle control quantity B and a plurality of relations between the steering angle θ and the velocity V are prepared. Depending on the selected map data, therefore, the action characteristic of the automobile model 3 varies. For example, when the same steering quantity A is given in FIG. 6A, the steering angle θ becomes relatively smaller in the steering map 2 than in the steering map 1. When the steering map 2 is selected, therefore, it becomes harder for the automobile model 3 to make a turn than when the steering map 1 is selected. When the same throttle control quantity B is given in FIG. 6B, the velocity V becomes relatively lower in the velocity map 2 than in the velocity map 1. Therefore, the maximum velocity of the automobile model 3 is restricted to a lower value when the velocity map 2 is used than when the velocity map 1 is used. Incidentally, the velocity map N is a special setting example. If the velocity map N is selected, the velocity V is restricted to a constant value when the throttle control quantity A has exceeded a predetermined value. The velocity map N is suitable for the case where the automobile model 3 is forced to travel at a low velocity.

The map data DI used by the steering information control section 10a is altered on the basis of traveling restriction information sent from the outside, especially the management machine 4, or on the basis of the traveling log data D2.

FIG. 8 is a flow chart showing processing of the steering information control section 10a in the case where the traveling

restriction information (see FIG. 5D) is sent from the management machine 4. If the received data discrimination section 10d of the controller 2 has received the traveling restriction information sent from the management machine 4, then the received data discrimination section 10d supplies that traveling restriction information to the steering information control section 10a. As shown in FIG. 8, the steering information control section 10a conducts monitoring to determine whether traveling restriction information has been received (step S10). If the traveling restriction information has been received, then the steering information control section 10a selects map data according to the contents of the traveling restrictions (step S11). For example, if traveling restriction information that restricts the maximum velocity has been received, the steering information control section 10a newly selects velocity map data located on the lower velocity side than the currently selected velocity map data. Besides, the velocity restriction information supplied from the outside may specify various contents. It is also possible to make the automobile model 3 send the traveling restriction information and alter the map data D1 on the basis of the information.

FIG. 9 is a flow chart showing a procedure of traveling management processing executed repetitively by the steering information control section 10a of the control device 10 in order to alter the map data D1 on the basis of the traveling log data D2. In the traveling management processing, the traveling log data D2 is first analyzed (step S20). Since operation history

is preserved in the traveling log data D2, it is possible to acquire traveling time of the automobile model 3 after the race start or information that is correlative to the traveling time, on the basis of, for example, the number of times of update. Subsequently, it is determined whether the traveling time has reached a predetermined limit time on the basis of information acquired from the traveling log data D2 (step S21). When the limit time is not reached, traveling restrictions are set according to the content of the traveling log data D2 (step S22). For example, in conjunction with the increase of the number of times of operation on the steering control section 2a and the throttle control section 2b, the steering map is gradually switched toward the side on which the steering angle becomes relatively smaller. By conducting such control, it becomes gradually harder for the automobile model 3 to make a turn as it continues to travel. Therefore, a state in which the steering characteristic is changed by tire wear is represented. As regards the velocity map, it is considered, for example, that the velocity map is gradually altered to a velocity map on the higher velocity side as the operation time increases. In this case, it is possible to represent the state in which the automobile model weight is reduced by reduction of fuel and the maximum velocity is increased. On the other hand, when the traveling time has reached the limit, traveling restrictions according to an excess over a restriction time are set (step S23). For example, by selecting the velocity map N of FIG. 6B, it is possible to forcibly bring out a state in which low velocity traveling

is forced by fuel shortage or a tire limit.

After the processing of the step S22 or S23, it is determined whether pit-in information has been received (step S24). The pit-in information is information sent from the automobile model 3 as a kind of the traveling state notification information shown in FIG. 5C when the image reader 26 of the automobile model 3 has detected the bar image 5d of the pit lane 5b. Upon receiving pit-in information having the same ID number as the ID number set by the ID setting switch 11, the received data discrimination section 10d of the control device 10 supplies its pit-in information to the steering information control section 10a. Upon receiving the pit-in information, the steering information control section 10a cancels the traveling restrictions and selects, for example, the steering map and the velocity map specified as initial values (step S25). Incidentally, as for the traveling restrictions set in the processing of FIG. 8 as well, cancel of the traveling restrictions of the step S25 may be executed.

FIG. 10 is a flow chart showing a procedure of lap information notification processing executed by the lap decision section 20c of the automobile model 3. In this processing, the lap decision section 20c determines whether the image reader 26 has read a bar image (step S30). If it is judged that a bar image has been read, then the read pattern is discriminated (step S31). In other words, it is determined which of the bar image 5c of the main course 5a or the bar image 5d of the pit lane 5b has been read. If the bar image 5c is judged to have been

read, then the transmission data generation section 20e is ordered to generate lap information. If the bar image 5d is judged to have been read, then the transmission data generation section 20e is ordered to generate pit-in information (step S32). As a result, the lap information or the pit-in information is sent from the automobile model 3 every time the automobile model 3 laps the course 5. When the pit-in information sent in this processing is received by the controller 2 having the same ID, the traveling restrictions are canceled as described above.

On the other hand, the lap information transmitted from the automobile model 3 is used in race management executed by the race control section 40a of the management machine 4. FIG. 11 is a flow chart showing a procedure of the race management processing. The race control section 40a conducts monitoring to determine whether lap information has been sent from any automobile model 3 (step S40). Upon receiving the lap information, the race control section 40a updates race situation data D3 (FIG. 4). The race situation data D3 contains various kinds of information required to grasp the race situation, such as order and the number of laps of the automobile 3. It is then determined on the basis of the race situation data D3 whether the top automobile model 3 has arrived at the final lap in the prescribed number of laps (step S42). If the lap is not the final lap, then it is determined whether the race is finished, i.e., whether the top automobile model 3 has reached the goal (step S43). If the race is not finished, then the race control section 40a proceeds to step S45. If the lap is judged to be

the final lap, then the race control section 40a gives a notice of the final lap via the information display section 4b (step S44). Then the the race control section 40a proceeds to step S45.

At step S45, traveling restrictions are set on the basis of the race situation data D3. For example, in order to maintain the tension by setting a handicap according to the order, the traveling restrictions of each automobile model 3 are set so as to restrict the maximum velocity to a lower value as the order becomes higher. Thereafter, the transmission data generation section 40b is ordered to generate traveling restriction information based on the setting result (step S46), and the race control section 40a returns to the step S40. Upon being ordered to generate traveling restriction information, the transmission data generation section 40b generates traveling restriction information so as to be associated with the ID of each automobile model 3, and makes the Bluetooth communication module 42 transmit the traveling restriction information in order. When the controller 2 has received the transmitted traveling restriction information, the processing of FIG. 9 is executed and the traveling restrictions are enforced. If the race is judged at the step S43 of FIG. 11 to be finished, then race termination processing, such as fixing the order of the automobile model 3, is conducted (step S47).

FIG. 12 is a flow chart showing procedures of crash information notification processing conducted by the damage decision section 20d of the automobile model 3 and damage

reproduction processing executed by the vibrator control section 10e of the controller 2 upon receiving the crash information. In the damage reproduction processing, the damage decision section 20d conducts monitoring to determine whether vibration acceleration detected by the acceleration sensor 27 has exceeded a predetermined value (step S50). If the predetermined value is exceeded, then the damage decision section 20d orders the transmission data generation section 20e to generate crash information (step S51). Therefore, when vibration acceleration that is not generated in the ordinary traveling state is caused by, for example, the automobile model 3 getting out from the course, crash information is generated so as to be associated with the ID of the automobile model 3, and sent from the automobile model 3. If the crash information sent by this processing is received by the controller 2 having the same ID, then the received data discrimination section 10d of the controller 2 supplies the crash information to the vibrator control section 10e. As a result, the vibrator control section 10e starts the damage reproduction processing of FIG. 12 and generates vibrator driving information (step S60). On the basis of the driving information, the vibrator control section 10e gives a driving order to the vibrator driving circuit 14 so as to drive the vibrator 15 (step S61). By such processing, it is possible to reproduce a damage generated in the automobile model 3, on the controller 2 and enhance the reality of the play.

FIG. 13 is a flow chart showing a procedure of manual management processing executed by the race control section 40a

of the management machine 4 in order to manage the race progress on the basis of information sent from the controller 2 and information input from the information input section 4a of the management machine 4. In the manual management processing, it is determined whether predetermined penalty setting operation has been conducted on the information input section 4a (step S70). If the penalty setting operation has been conducted, then the transmission data generation section 40b is ordered to generate penalty traveling restriction information according to the setting operation (step S71). The penalty setting operation is operation for imposing a predetermined penalty, such as a restriction of the maximum velocity, on an automobile model 3 that has conducted traveling violating predetermined rules, such as a rear-end collision or a traveling disturbance. Contents of the penalty setting operation and penalty traveling restrictions may be determined suitably.

The penalty traveling restriction information generated on the basis of the order of the step S71 is sent from the management machine 4 as a kind of the traveling restriction information shown in FIG. 5D. Upon receiving the penalty traveling restriction information associated with the same ID as the own ID, the controller 2 alters the map according to the procedure shown in FIG. 9 and thereby generates a penalty. The penalty traveling restrictions are canceled by traveling on the pit lane 5b (the step S25 of FIG. 9).

A user of an automobile model 3 indisposed for traveling by a contact with another automobile model or the like is allowed

to conduct operation of notifying the information input section 2c of the controller 2 that traveling is impossible. Upon operation of notifying that traveling is impossible, the additional information control section 10b of the controller 2 orders the transmission data generation section 10c that the traveling impossibility notification information should be included in the transmission data of FIG. 5B as the additional information. The race control section 40a of the management machine 4 conducts monitoring in the manual management processing to determine whether such traveling impossibility notification information has been sent from any controller 2 (step S72). If the traveling impossibility notification information has been sent, then the race control section 40a orders the transmission data generation section 40b to generate traveling restriction information for traveling impossibility (step S73). The traveling restriction information for traveling impossibility is generated as, for example, information for ordering all controllers 2 to select the velocity map N shown in FIG. 6B. In this case, all automobile models 3 lap on the course 5 at a low velocity restricted by the velocity map N. As a result, a measure for preventing differences from increasing until recovery from a fault can be implemented on the race. Such traveling restriction information corresponds to a kind of broadcast data.

Return from the state in which the traveling restrictions for traveling impossibility are imposed can be effected by conducting a predetermined cancel operation on the information

input section 4a of the management machine 4 or conducting a predetermined cancel operation on the information input section 2c of the controller 2. The race control section 40a of the management machine 4 conducts monitoring in the manual management processing to determine whether such cancel operation has been conducted on the traveling impossibility state (step S74). If the cancel operation has been conducted, then the race control section 40a orders the transmission data generation section 40b to generate information for canceling the traveling restrictions caused by the traveling impossibility state (step S75). As a result, the information for canceling the traveling restrictions is transmitted to each controller 2. Upon receiving the information for canceling the traveling restrictions, the steering information control section 10a in the controller 2 switches the map data to, for example, map data used immediately before the traveling restrictions based on the traveling impossibility state were imposed, and the race is continued. Each controller 2 may be adapted to select map data set as the initial value. While the user conducts operation of notifying the controller 2 of the traveling impossibility state in the above described manual management processing, the user may conduct such an operation for the information input section 4a of the management input section 4a.

The present invention is not limited to the embodiment heretofore described, but it can be embodied in various forms. For example, the following variants are considerable.

(1) It is possible to omit the management machine 4, and

implement various kinds of processing by communication between the controller 2 and the automobile model 3.

(2) In the case where each controller 2 has received traveling impossibility notification information, each controller 2 forcibly selects the velocity map N. As a result, the same traveling restrictions as those described above can be implemented.

(3) A posture detection device such as a slope sensor is provided in the automobile model 3. The control device 10 of the automobile model 3 determines whether a fault such as lateral turning has occurred. When a fault has occurred, the automobile model 3 is made to send traveling impossibility notification information. Upon receiving the information, each controller 2 selects the velocity map N. In this case as well, traveling restrictions similar to those of (2) can be implemented.

(4) Traveling log data is recorded in the management machine 4. Traveling restriction information based on the traveling log data may be transmitted from the management machine 4 to the controller 2.

(5) Traveling restriction information sent from the management machine 4 is received by the automobile model 3. A change of the action characteristic according to the contents of the restrictions may be generated by the control device 20 of the automobile model 3. For example, the motor driving control section 20b of the control device 20 of the automobile model 3 may compute the product of a velocity specified by the controller 2 and a predetermined ratio as an actual velocity, and control

the traveling motor 22 on the basis of the computed velocity.

Besides, various forms are included in the present invention. The model is not limited to the automobile model, but the present invention can be applied to various models such as tanks, trains, ships, airplanes and robots. The accessory device is not limited to the management machine. For example, a device that is disposed on a field on which tanks travel or on a track on which trains travel and that conducts various actions is included in the concept of the accessory device.

As heretofore described, according to the present invention, each of the controller, model and accessory device has a radio communication module based on the same standards. Therefore, it is not necessary to mount a plurality of communication modules on the model, and consumption of the battery can be suppressed. Therefore, the size of the model can be advantageously reduced. In addition, bilateral data communication among the controller, the model and the accessory device is possible. Therefore, various data can be exchanged among them and various controls can be implemented. As a result, the interest of the play implemented by the remote control of the model can be enhanced.